Mycological Notes.

By Byron D. Halsted.

A Pineapple Mould.—Some specimens of decayed pineapple obtained in the market when sliced and placed in moist chambers in the laboratory developed in 36 hours a profuse and pure culture of a beautiful mould, which at first sight might have been mistaken for the common *Penicillium.* When microscopically examined, however, it was determined that it was a species of Chalara, and agrees quite closely with *Chalara paradoxa* (de Seynes) Sacc., described in Sylloge Fungorum, **10**: 595, and recorded for decaying pineapple in Paris, France.

The fungus as it appears upon the sliced pineapple may be quite completely divided into two portions. One consisting of hyaline perpendicular threads giving the mould in its early stages a frosty appearance not unlike that of *Peronospora* upon the leaf surface of their hosts, only much more magnified. Below and close to and even within the substance of the pineapple there soon follow a second spore development, which is also profuse, and on account of the prevailing olive color of the spores the whole appearance suggests, as before stated, that of the *Penicillium.*

The two forms of spores are very different, both as to their size and color and their method of formation. The first form of spore is usually hyaline, cylindrical, obtuse, and from 4–5 by 6–10 μ, while the second form is ovoid, oblong, olive brown and 8–9 to 16–18 μ.

The hyaline form of spore, which may be called the microspore, is formed endogenously and new spores are pushed out from the open end of a tip with considerable rapidity. The *Chalara* admits of easy cultivation in Van Teighem cells and the exogenous formation of these spores may be readily seen under higher powers of the microscope.

Before any spores have become separated from the long, straight tip of the filament there is a rounding off and a separation of the contents in the upper 10 μ of the tip. Following this there is a rupturing of the cell wall at the end of the hypha, and

shortly after a spore pushes its way out and becomes free. This is followed by the abjunction of masses of the hypha contents so that usually there may be seen from 3–5 of the double cross walls in the mother cell. One of the peculiarities noticed in this study of spore formation was the size of the first spore produced, it being uniformly, almost, exactly double that of the succeeding spores that were pushad out of the tube. The rapidity with which these spores are formed may be judged from the fact that a culture 18 hours old had on an average of 10 spores at the tip of each tube, and in many instances the number was as high as 23. The time required for the production of the hypha themselves is not known exactly in this case; but by actual timing of the production of some of the spores it is determined that from 20 to 30 minutes is all sufficient for the pushing out of a spore and the taking of its place at the mouth of the tube by its successor, and in some cases the time required is reduced from 15–20 minutes. It is not usual for these spores to form and remain in rows after they have escaped; but under the circumstances under which they were observed they formed little irregular groups at the ends of the mother tubes. While this form of spore production is not new it is nevertheless infrequent. My first personal knowledge of it was in connection with the study of the sweetpotato black rot fungus *Ceratocystis fimbriata* Ell. & Hals. The observation first being made with this species by Mr. Fairchild, who at the time was investigating the potato decay in my laboratory. This method of spore production is treated in a paper upon the *Ceratocystis* in the Journal of Mycology, Vol. 7, No. 1, and the endogenous form of the conidia is given on pages 5 and 6 with several references to previous articles bearing upon this peculiar formation of spores. A plate given in *Botanische Zeitung*, 1847, there referred to, shows very well this peculiar method of spore formation. However, I do not observe that any mention is made of the double size of the first spore, and there is no indication in the figure of adjunction of the spores within the tube. Dr. Zopf, in like manner in "Die Pilze," Figure 61, shows the same method of spore formation as taking place in *Thielavia basicola* Zopf.

The second form of spore has been studied, and there is not

the slightest indication of endogenous form. In this respect it differs materially from the macroconidia of the *Ceratocystis* which Mr. Fairchild demonstrated was produced in the same way by abjunction within the mother cell as above demonstrated for the microconidia. On the other hand, these spores are produced in chains of remarkable length and beauty in the Van Teighem cultures, there being sometimes 50 or more of the olive brown spores exceedingly uniform in size and holding together, even when the chains of spores have been distorted into extravagant shapes.

That these two forms of spores belong to the same plant was demonstrated beyond question, because sometimes from the same hypha there was given off upon the right hand a branch which developed endogenously the microconidia, while a few micromillimeters above or below and the opposite side a branch segmented into a chain of the macroconidia.

By taking portions of the *Chalara* from beneath the surface of the pineapple it was easily demonstrated that spores were produced from the subterranean filaments, which, while probably belonging to the macroconidia, differed from them both in shape and color, they being much longer and narrower, and of an almost pale blue color, besides these were formed at the tip of the hypha, and usually singly or, at the utmost, in chains of two or three spores. What was perhaps of more interest still is a form of spore agreeing in color quite closely with the macroconidia, but in size more nearly those of the hyaline microconidia. These were produced in long chains which easily fell apart and were associated with both the other above-mentioned forms. At first sight it would seem as if the hyaline, cylindrical, somewhat abrupt ended microconidia had become rounded and taken on a thicker cell wall and brown coloration ; but the formation of these spores is by ordinary fission of the hypha, and agrees in that respect with the macroconidia.

It would seem, therefore, that in our *Chalara* there are three quite well defined kinds of spores, not counting the ones that are produced within the mass of the host, and as far as this goes it well bears out the specific name of the species, *paradoxa*. With a knowledge of the fact that associated with the two forms of co-

nidia in the *Ceratocystis* there is a pycnidia development, search was made for this structure in the pineapple cultures; but nothing of the sort has appeared. It is, however, true that the pycnidial development in the *Ceratocystis* was shy and not met with but a few times during the study of the sweetpotato black rot. Therefore realizing the great similarity between the microconidia in form and in method of production in the two genera and of the macroconidia in their structures, but not in their origin, one is inclined to continue the search for a pycnidial form of fungus in the case of *Chalara paradoxa.*

Notes upon Peach Root Galls.—After a study of the root knot or gall of the peach, chiefly from the standpoint of possible remedies, for the past two seasons, it may be well to put on record the fact that a fungus similar to the one noted above upon the pineapple is associated with the enlargements at the crown and elsewhere upon the roots of the peach.

The microconidia are hyaline and 10–15 by 3–4 μ, produced endogenously as for *Chalara* and *Ceratocystis.* The microconidia are olive-brown, oval 10–13 μ and formed by ordinary fission, and in that feature agree with *Chalara* and not with *Ceratocystis.* In its habitat it agrees with the latter in that both are soil fungi, the ceratocystis, as stated in the proceeding note, feeding upon the roots of the sweetpotato, and this one is upon the roots of the peach.

The fungus has been frequently met with upon crown and roots of seedling peaches while only a few weeks old and before any galls had started, and also at the end of the season, when galled roots were examined closely, the fungus being upon the surface of the knots and producing a dark color from the multitudes of dark macroconidia.

It remains to demonstrate, if possible, the causal connection of the fungus with the formation of the galls.

Natural Enemies of the Asparagus Rust.—The season of 1896 was the first one in which the genuine rust of the Asparagus (*Puccinia Asparagi* DC.) had been observed in this country outside of California. Since last year the disease has widened its range greatly and has become so severe that asparagus growers have full cause for alarm.

This fungus is one of the Uredineae having its three forms of spores produced upon the same host and, therefore, the student does not need to look elsewhere than upon the Asparagus for the aecidial, uredo, and teleutosporic forms of fruitage.

During the season now closing the cluster cups were first found upon specimens sent to the experiment station June 3d. An examination of these plants showed that the aecidial cups are in oval clusters. Frequently the cups were arranged as a border to the oval sorus and all within were spermagonia. Other sori are entirely spermagonial with no signs of aecidia. The spermagonia are easily distinguished by their small size and the watery appearance they give to the diseased spot.

The uredo form is frequently associated with the aecidia and its spores are produced in longitudinal slits in the epidermis in such abundance as to give the brownish color characteristic of the rusted plant. When associated with the clusters of aecidia the uredo sori are usually near to, but just outside of, the oval orange area devoted to cups and spermagonia.

The teleutospores when with the cluster of aecidia are quickly distinguished by the dark color due to the spores and their elevation above the level of the host. The sori of teleutospores occur anywhere in the aecidial cluster; thus, there may be one dark rift in the center of the cluster of cups or it may be close to the border, where it is often quite long.

It is seen from this that the asparagus rust appears in all of its forms almost simultaneously and often in the same disease spot. In short, several rust spots exhibited only spermagonia, others a mixture of these and the aecidia, while others had these two and the uredo or the teleutospore or both, so that a single diseased patch half the size of the little finger nail may contain all four forms. This matter of observation admits of the interpretation that all forms develop from the same unit of hyphae.

The aecidial form is the first one in the fungus life cycle, it being met with as early as June 3d, before stated, upon asparagus plants sent to the station from a center of the asparagus industry in the State. At that time the cutting of the beds was at its height and the rust was confined to the young plants that were allowed

to form "brush" and gain strength for cropping in future years. The first specimens of all were found upon plants that sprang up and were allowed to grow in land that had been in asparagus but rooted out and used for other crops. These vigorous volunteer shoots were covered with the aecidia, and doubtless produced a large crop of spores in readiness to inoculate the plants that came later in the season upon the regular beds.

It is interesting to note that while they were looked for throughout the season, and upon thousands upon thousands of plants, not an aecidium was ever met with except upon the volunteer plant, on those that starting early and unmolested produced brush long before the regular bed plants had shown above the surface. It would seem from this that the cluster cups need to form early in the season or they will not appear at all.

Associated with *Puccinia Asparagi* DC. there are at least two natural enemies in which the growers of asparagus may have some hope of assistance. One of these is associated particularly with the aecidial form and is the *Tubercularia persicinia* Ditt., which is quickly recognized in the sorus by its purple color. This fungus is recorded for the Uredineae generally and it is a pleasure to find it in an economic rôle.

A second fungus, *Darluca filum* Cast., quite frequently infests the puccinia. It produces its mycelium in the rifts sometimes to the exclusion from view of all the spores of its host, transforming the sori bearing the orange powder into those filled with blackish, shining, minute, bead-like bodies. From these pycnidia the spores at maturity issue in fine white coils and frequently give the whole asparagus plant an appearance of being the victim of a downy mildew.

It is not known how much good this parasite may do, but judging from the present season it has a large field in which to operate.

OCTOBER 28, 1897.